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ABSTRACT

In response to the large numbers of students who were failing or dropping out of basic algebra and calculus classes, Cottey College, in Missouri, developed a math placement program in 1982 using Basic Algebra (BA) and Calculus Readiness (CR) tests from the Mathematical Association of America's Placement Testing Program. Cut off scores for the tests were determined by relating student success rates to test scores during a 10-year period. In addition to BA and CR scores, other criteria for making recommendations include American College Testing and Scholastic Aptitude Test math scores and years of high school math taken. The program showed an immediate improvement in success rates, with the percentage of students achieving at least a "C" in basic calculus increasing from 58% in 1980-81 to 78% in 1984-85, 2 years after the program was implemented. Moreover, the program has provided increased knowledge about Cottey's students and aided in identifying and addressing concerns in the college's math program. For example, an intermediate algebra course has been added to the curriculum to meet the needs of students with 2 or 3 years of high school math but low BA test scores. Data tables are provided showing student success rates, placement program effectiveness, the relationship between placement level and graduation rate, and the relationship between class attendance and final grades. (KP)

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MATHEMATICS PLACEMENT AT COTTEY COLLEGE

By Susan Callahan
Presented at the American Mathematical Association
of Two-Year Colleges Annual Conference, November 19, 1993

Cottey College is a private, two-year women's college located in Nevada, Missouri. Cottey offers a liberal arts curriculum with emphasis on transfer to a four-year school. As a whole, the approximately 350 students are somewhat above average, but there is a tremendous range of backgrounds and abilities. ACT math scores for a recent freshman class ranged from 12 to 30. A few students have taken only general math in high school; a few have had a year of calculus.

In 1980 Cottey offered only two entry-level classes, Calculus I and College Algebra. Placement was based on ACT math scores and years of high school math, using criteria that were used at a major university with no follow-up to see if they were appropriate for Cottey. Large numbers of students were dropping classes or failing, and faculty were very uncertain about how to direct advises to suitable math courses. I felt that a better job could be done and began a program of placement testing and follow-up studies in 1982. The tests used are the Basic Algebra (BA) and Calculus Readiness (CR) tests of the Mathematical Association of America's Placement Testing Program. Currently almost all entering students are tested during new student orientation. Students who earn AP credit for calculus or who transfer credit for a math class taken at another college are not tested, but all other new students are assigned to either test BA or CR.

The placement test scores, ACT/SAT math scores and years of high school math are all considered in making recommendations, and criteria used are based on the actual performance of previous years' students. In this presentation I will show data for Calculus I. Similar work has been done for College Algebra. To determine cutoffs, I began by relating success rates to placement test scores. I define success as earning a C or better in the course. Grades of D, F, and W (drop) are considered unsuccessful. Figure 1 shows the success rate of all students earning each CR test score during a ten-year period. N is the number of students earning that score. A very clear break between 11 and 12 can be seen. Students scoring 12 or higher seem to be prepared for Calculus.

I next investigated whether, for students scoring 11 or lower, there was a way to distinguish those who are successful from those who are not. For this group I looked at years of high school math and ACT/SAT math scores. Figure 2 summarizes the results. Only college preparatory courses passed are counted in years of high school math. The ACT scores are from the "old"

test before the 1990 revision. The ratios indicate the number successful over the total number in each group. As you would expect, students with more years in high school do better and students with very high test scores tend to be successful.

The placement criteria which evolved from the data analysis are presented in Figure 3. The score on the CR placement test is considered first. If the score is below 11, years of high school math are considered next. For those students with four years of high school math, ACT is also considered. There is still one category (ACT 26-29) where about 50% of the students are successful. At first I worried about which course to recommend for such students, but I now make a recommendation of borderline and let the student decide which course to take. This is consistent with Cottey's philosophy that the student is responsible for her own education. Academic advisors provide information and make suggestions, but the final determination of which classes to take is made by the student. The placement program, even with a borderline recommendation, gives students information on which to base their decisions.

The placement program did show an immediate improvement in success rates. Figure 4 shows the success rates in Calculus I for the two years before and the three years after placement testing began. Recently the success rates have fallen. I do not know why, but I think it has more to do with student maturity and work ethic than with the placement procedure. The composition of the class also should be considered. The "ALL" column in Figure 4 includes all students enrolled in Calculus I each year. The "OK" column gives the success rates for just those students who placed into Calculus I, which I believe is a better indicator of whether the recommendations are accurate.

Another aspect involved in determining if the recommendations are accurate is whether students who take a more advanced course than recommended are successful. In the past four years, nine students who placed into College Algebra chose to take Calculus I. One earned a B, one earned a C-, and seven earned D, F, or W (drop). This gives a substantially lower success rate than for students who do place into the class.

Overall, the program has been successful at guiding students toward the correct math class, and advisor anxiety has been reduced because faculty have the information they need. Another benefit has been the increased knowledge about Cottey students and courses gained by working with the data. This has allowed me to identify and address concerns in the math program.

I put this information to use when the assessment issue came up. In the 1991-92 school year Cottey was working on a self-study for reaccreditation by the North Central Association. An institution being evaluated that year was expected to have a plan to implement an assessment program, and our faculty were asked to

submit any assessment of our academic programs which was currently being done. Of course that leads to the question "What is assessment?" According to the Assessment Workbook written by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools (1991), an assessment program "...should provide information that assists the institution in making useful decisions about the improvement of the institution..." I think that the data I collected do exactly that and I will present several examples which I submitted for the self-study.

The first change in Cottey's math program as a result of math placement data was the addition of Intermediate Algebra to the course offerings. I showed there was a need for the course by first looking at what sort of high school preparation led to success in College Algebra. Figure 5 shows the success rates in College Algebra for students with varying years of high school preparation and ACT/SAT math scores for the three years before Intermediate Algebra was proposed. I concluded that students with only one year of high school math and many of the students with two or three years but test scores below 18 ACT/400 SAT would profit from Intermediate Algebra. Figure 6 shows the number of students in a typical freshman class of 200 who fall into each category. Adding the 11 students with one year of high school math and 55% of the 46 students with two or three years of high school math but low test scores gives a total of 36 students (almost 20% of the freshman class) needing Intermediate Algebra. The College was convinced of the need and the course was added to the curriculum.

I have done some pre- and post-testing during the years I taught Intermediate Algebra. The BA placement test was given during orientation and during the last week of classes. Figure 7 shows the average BA scores before and after the course for students who participated in both testings. There is a significant improvement. The third column shows the percent of students increasing their scores 7 points or more. There is some evidence that such an increase is related to subsequent success in College Algebra.

One purpose of Intermediate Algebra is to prepare students for College Algebra. Figure 8 suggests that this goal is being met. The first column gives the success rate in College Algebra for students who placed into and took that course. The second column gives the success rate in College Algebra for students who placed into Intermediate Algebra and completed that course with a grade of C or better before enrolling in College Algebra. The third column gives the success rate in College Algebra for students who placed into Intermediate Algebra but chose to enroll directly in College Algebra. Students who place into Intermediate Algebra and successfully complete the course do as well in College Algebra as students who place into College Algebra, while those who bypass Intermediate Algebra have a much lower success rate.

The next issue I expect to address concerns the College's math requirement and the number of sections of each course to offer. The current general education requirements call for six hours of math (College Algebra or higher) or science--it is possible to earn an associate's degree without taking math. The College is considering changing the requirement to one math course and one science course. Students who are not currently taking math will have to be accommodated in our classes. To plan the number of sections of each course needed, it is useful to know the number of freshmen who currently avoid math. Figure 9 gives the number of freshmen who do not take math broken down by placement level. The percentages are the percent of students at that placement level who do not take a math course, and N is the size of the freshman class. As one would expect, stronger students take math while lesser prepared students avoid it. If one math course is required for the associate's degree, the College will need additional sections to accommodate 20-25 students in Intermediate Algebra and 45-50 students (including those who take Intermediate Algebra first) in College Algebra.

My final two tables show data I compiled out of curiosity. Figure 10 shows the relation between placement level and graduation rate. The percent of students at each placement level who completed the associate's degree in two years is given. Students who place into Intermediate Algebra do not persist at as high a rate as better prepared students.

At the end of a particularly frustrating semester, I compiled data relating attendance and grades. I was teaching three sections of College Algebra with a total of 87 enrolled. Approximately 30 had excessive absences, which I define as missing more than three classes. Figure 11 shows the number of students earning each grade and having three or fewer absences, four or five absences, or six or more absences. The success rate for each attendance level is also shown. For my College Algebra students this particular semester, the success rate for all students who placed into College Algebra was 55%, while the success rate for students who placed into College Algebra and had three or fewer absences was 75%.

In conclusion, the math placement program provides accurate course recommendations to students and has expanded to provide information which will continue to lead to improvements in Cottey's math program.

SUCCESS RATES

CALCULUS I FALL '82-FALL '91

CR	RATE	N
≥15	96%	50
14	84%	25
13	85%	13
12	81%	26
11	54%	26
10	60%	20
9	47%	15
8	75%	12
≤7	53%	17

Figure 1

CR BELOW 12

1982-'89 (8 YEARS) 'OLD' ACT

ACT SAT	YEARS IN HS 5	4	3	TOTAL
≥28	4	9	0	57%
600'S	4	15	4	
25-27	3	11	2	50%
500'S	7	22	3	
≤24	2	4	0	46%
400'S	2	10	1	
	69%	57%	25%	

Figure 2

PLACEMENTS

CR ≥ 12 — CALC I

CR ≤ 11

- 5 YRS HS — CALC I
- 4 YRS HS
  - ACT ≥ 30 — CALC I
  - ACT 26-29 — BORDER
  - ACT ≤ 25 — COL ALG
- 3 YRS — COL ALG

Figure 3

EFFECTIVENESS

YEAR	% ≥C
80-81	58%
81-82	67%
82-83	73%
83-84	80%
84-85	78%

	ALL	OK
89-90	52%	68%
90-91	76%	90%
91-92	68%	69%
92-93	63%	73%

Figure 4

SUCCESS RATES IN COLLEGE ALGEBRA

1982-1984

ACT/SAT

YEARS HS	≥24 ≥500	18-23 400's	15-17 350-390	LOWER
4	94%	72%	100%	
3	98%	73%	61%	58%
2	100%	76%	55%	55%
1	11% for students with less than 2 years of high school math			
0				

Figure 5

FRESHMAN CLASS DISTRIBUTION--1984

YEARS HS	ACT/SAT ≥24 ≥500	18-23 400's	15-17 350-390	LOWER
4	25	16	4	0
3	24	26	10	9
2	1	15	6	21
1	1	1	3	6

Approximately 11+ (55% of 46) = 36 students need Intermediate Algebra

PRE/POST SCORES IN INTERMEDIATE ALGEBRA

SEM	BA SCORE BEFORE	BA SCORE AFTER	INCREASE ≥7 POINTS
F 90	9.0	15.1	41%
F 89	9.1	14.8	33%
F 88	9.7	15.7	45%
F 87	9.0	14.6	30%
S 85	7.9	12.8	

Figure 7

SUCCESS IN COLLEGE ALGEBRA

BY PLACEMENT LEVEL

YEAR	PLACED COL AL	TOOK INT AL	PLACED INT AL
F 1991	65%	---	20%
1990-91	57%	50%	22%
1989-90	63%	67%	50%
1988-89	63%	54%	25%
1987-88	72%	75%	50%
TOTAL 1987-91	63%	59%	38%

Figure 8

FRESHMEN STUDENTS AVOIDING MATH

PLACEMENT LEVEL

YEAR	CALC I	COL ALG	INT ALG	N
1991	5 14%	23 20%	23 38%	212
1990	4 9%	27 24%	25 35%	222
1989	2 8%	21 19%	22 40%	210
1988	5 16%	23 23%	22 34%	197

Percents are the percent of students at that placement level who do not take a math course during the freshman year.

Figure 9

DEGREE COMPLETION BY PLACEMENT LEVEL

YEAR ENTERING	CALC I	COLLEGE ALGEBRA	INTERM ALGEBRA
1990	73%	57%	42%
1989	44%	68%	45%
1988	71%	58%	37%
1987	73%	76%	44%
1986	74%	72%	54%

Figure 10

ABSENCES AND GRADES

	0 - 3	4-5	6 OR MORE
A	4	0	0
B	18	1	1
C	13	4	0
C -	3	2	0
D	8	5	3
F	6	0	8
DROP	5	0	5
SUCESS RATE	61%	42%	6%

Success rate for all students who placed into College Algebra: 55%.

Success rate for students who placed into College Algebra and had 3 or fewer absences: 75%.

Figure 11